

# PATENT SPECIFICATION

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## (54) A METHOD OF INCREASING THE HEIGHT OF A COLUMN OF SMOKE DISCHARGED FROM A CHIMNEY

(71) We, AGENCE NATIONALE DE VALORISATION DE LA RECHERCHE, a Public Institution organised and existing under the laws of France, of Tour Aurore, 5 Paris-Defense, Courbevoie, Hauts-de-Seine, France, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in 10 and by the following statement:—

The present invention relates to a method of increasing the height of the trail of smoke or of effluent having a noxious nature, discharged from a chimney or any other evacuation means, with a view to fighting against pollution of the atmosphere.

The actual multiplicity of the causes of atmospheric pollution is such that the fight against its effects can only be contemplated 20 in a diversified manner. Thus, amongst other things, in the case of industries which are sources of pollution, preventive action can be undertaken at two levels: purification of the effluents and improvement of the conditions of discharge. The present invention is precisely concerned with improvement of these discharge conditions.

The discharge of effluents is effected in a very general and conventional manner by 30 means of chimneys, the function of which is to ensure a sufficient height for the trail of effluent so that its diffusion into the atmosphere may be of adequate intensity and may thus ensure that the fall-out on the ground is included within permissible limits. 35 The fulfilment of this condition, taking into account the predominant meteorological data, together with the characteristics of layout and operation of factories or workshops 40 which are sources producing pollutants, would imply chimneys of considerable height which would therefore be very costly to build. On the other hand, lower chimneys are the origin of dangerous pollution.

45 The method according to the invention is especially directed:

[Price 33p]

- to avoiding fall-out on the ground and at small distances from the discharging source, which fall-out may have a high concentration during unfavourable meteorological or operating conditions, at the same time maintaining a reasonable height of chimney; 50
- in a general manner, to reducing the rate of pollution at small or large distances from the place of discharge by ensuring a dynamic increase in height of the trail of smoke and facilitating its diffusion; 55
- to permit a possible reduction of the dimensions of constructional work, the additional height of the trail of smoke and the reduction of pressure at the chimney head obtained by this method compensating for this reduction, all other things being equal. 60

According to the invention there is provided a method of increasing the height of the trail of smoke or of effluent discharged from a chimney or other evacuation conduit, which method comprises the step of blowing air into the atmosphere through a cylindrical sleeve which is coaxial with the chimney or evacuation conduit, which has a diameter greater than the diameter of the chimney or evacuation conduit, and has its output end located in the plane of the output end of the chimney or evacuation conduit, and injecting air only into at least one sector of the sleeve, preferably a sector or sectors facing the wind. 70

The invention also covers the installations for carrying into effect the method as defined above.

Other characteristics and advantages of the invention will be brought out more clearly in the description which follows below, reference being made to the accompanying drawings, in which:

Figure 1 is a diagrammatic view in elevation cross-section of the upper portion of a chimney equipped with a cylindrical sleeve in accordance with the invention; 90

Figure 2 is a view in plan-section of Figure 1,

Figure 3 is an explanatory diagram of the operation of the method of the invention and of the result obtained, the geometry of the blown air-intake circuit not constituting in any way a particular feature of the method;

Figures 4 to 12 are curves illustrating the results obtained by the utilization of the method of the invention in the case of Figures 4 to 10 inclusive respectively, of an annular blowing slot of 2.25 mm. with  $U_1/v=0.5$ ,  $U_1/v=1$ ,  $U_1/v=2$ , and for Figures 10 to 12, of an annular blowing slot of 5 mm. with  $U_1/v=1$ ,  $U_1/v=2$  and  $U_1/v=4$ .

Referring now to the drawings, there has been shown in Figures 1 and 2 a main conduit 1 of a chimney surrounded by a cylindrical sleeve 2 of greater diameter, the annular space 3 thus created serving to convey blown air to the output end of the sleeve which, as shown in Figure 3, is located in the plane of the output end of the chimney.

To reduce the necessary power consumption to the maximum extent the sleeve 2 is divided into three, four or  $n$  separate compartments 6, 7, 8, 9 or  $n$ , the blown portion of the periphery (see Figure 2) and injecting air only into that or those (8 and/or 9 for example) which are preferably facing the wind  $v$ .

Referring to Figure 3, the conduit 1 has a diameter  $d$ , the sleeve 2 has a diameter  $D$  and the annular space 3 has the dimension  $l$ . There has been shown diagrammatically at 4 the source of polluting gas or smoke  $F$  and at 5 and 5a the source of air blown into the sleeve 2. There has been indicated by  $v$  the speed of the wind, the speeds of the polluting gas and of the air (obviously variable) being indicated by  $U_1$  and  $U_2$ .

The distance under the wind is indicated at  $x$  and it is counted from the centre of the chimney.  $\Delta h$  represents the height of the axis of the smoke column  $A_p$  at the distance  $x$  measured from the top of the chimney, in the case of the application of the method of the invention, that is to say with blowing,  $\Delta h_o$  representing this same height at this same distance without blowing.

Assuming:

- 1) that the polluting gas at the output end of the chimney is at a temperature substantially equal to that of the blown air;
- 2) that the speed and temperature of the wind is substantially uniform; and
- 3) that the axis of the column  $A_p$  of smoke indicates the mean path of effluent plotted on points spaced from the common plane of the outlets from the chimney and the sleeve;

the series of curves of Figures 5, 6 and 7 shows that by plotting the value

$\Delta h$

$D$

as ordinates and the value  $x/D$  as abscissae for an annular blowing slot of 2.25 mm., for  $U_1/v=0.5$  (Fig. 5);  $U_1/v=1$  (Fig. 6);  $U_1/v=2$  (Fig. 7), and for blowing values  $U_2/v$  varying from 0 (no blowing) to 8, a very small blowing effect ( $U_2/v$  in the vicinity of 1 or 2) causes an increase in height ( $\Delta h/D$ ) of moderate amount while radically reducing fall-out in the immediate vicinity of the chimney.

Starting from the above results, the curves giving

$$\frac{\Delta h - \Delta h_o}{D} = f(x/D)$$

under the same conditions (Figs. 8, 9 and 10) bring out the advantage resulting from blowing or "gain" of the blowing. An examination of these curves shows that this gain is all the more appreciable when the ratio  $U_1/v$  is small, which corresponds to dangerous conditions of pollution.

The width  $l$  of the blowing slot and also the initial angle of inclination of the blown jet are parameters of the first importance and are adapted to the configuration of the chimney. The curves of Figs. 11, 12 and 13, which have been prepared under the same conditions as those of Figs. 5, 6 and 7 (but with a slot of 5 mm.) for  $U_1/v=1.2$  and 4 with  $U_2/v$  varying between 0 and 10 show, by comparison with Figs. 6 and 7 that the effectiveness of blowing is dependent more on the discharge speed of the air than on its rate of flow.

The carrying into effect of the method of the invention has the following advantages:

- The blowing circuit of the air is independent of that of the pollutant;
- Chimneys already constructed can be equipped, since it is only necessary to provide suitable arrangements at the tops of the external conduits bringing the air to a distributor, for example;
- When once assembled, the unit does not comprise any moving parts;
- The external aspect of the chimney is only slightly modified from the aesthetic point of view.

In addition, it should be observed:

- that wind direction is of no importance, the operation of the system which carries the invention into effect not being directional;
- that the utilization of an installation carrying the invention into effect remains very flexible; servicing can be resorted to even when conditions are unfavorable, thus reducing the exploitation costs to the strict minimum;

—that the method may be further improved by blowing hot air; 25

—that the installation may be provided with an automatic device for starting-up and regulation according to the value of the ratio  $U_1/v$ ; 30

—that in accordance with Bernoulli's theorem variation of pressure across the top of the chimney results in a depression which is favourable in two respects;

—It improves the draught conditions, 35

—and makes it more easily possible to stabilize the operation of burners associated with the chimney in the case of smoke caused, for example, by incineration of rubbish.

**WHAT WE CLAIM IS:—**

1. A method of increasing the height of the trail of smoke or of effluent discharged from a chimney or other evacuation conduit, which method comprises the step of blowing air into the atmosphere through a cylindrical sleeve which is coaxial with the chimney or

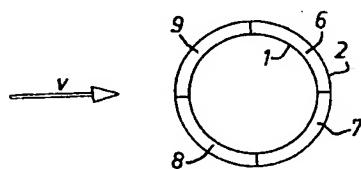
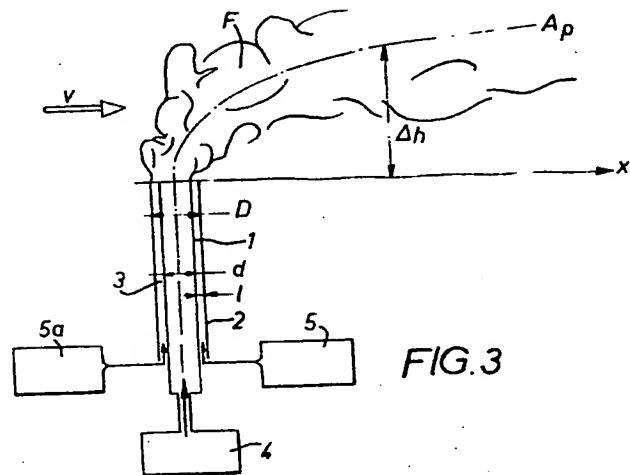
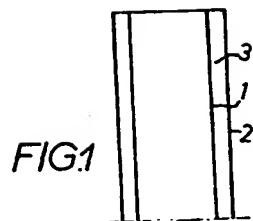
evacuation conduit, which has a diameter greater than the diameter of the chimney or evacuation conduit, and has its output end located in the plane of the output end of the chimney or evacuation conduit, and injecting air only into at least one sector of the sleeve, preferably a sector or sectors facing the wind.

2. Industrial installations or the like characterized by the fact that they utilize the method in accordance with Claim 1.

3. A method of and apparatus for increasing the height of the trail of smoke or effluent discharged from a chimney or other evacuation conduit in order to reduce fall-out of pollution, substantially as hereinbefore described and as illustrated in the accompanying drawings. 40

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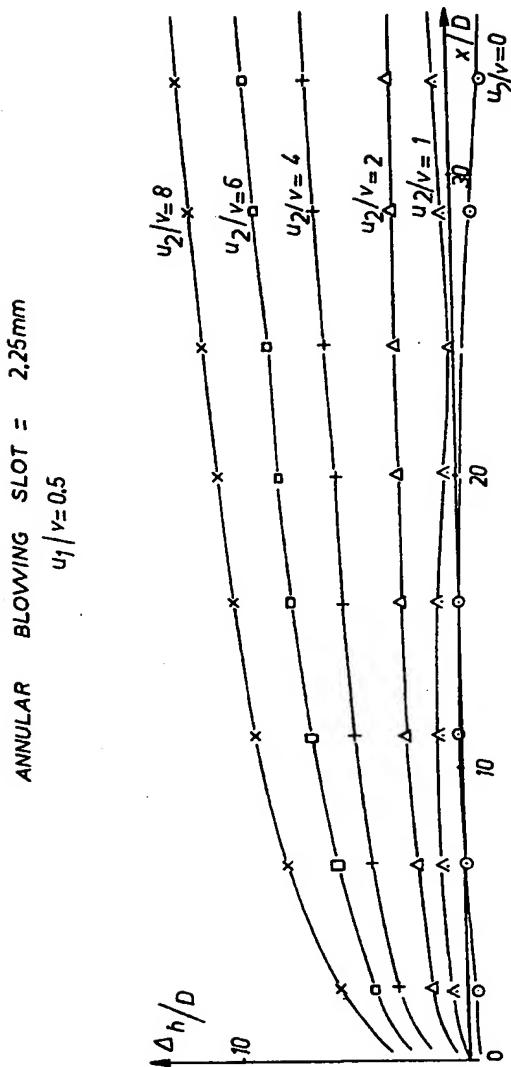


FIG.4

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10 SHEETS

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the Original on a reduced scale  
Sheet 3

ANNULAR BLOWING SLOT = 2.25mm

$u_1/v=1$

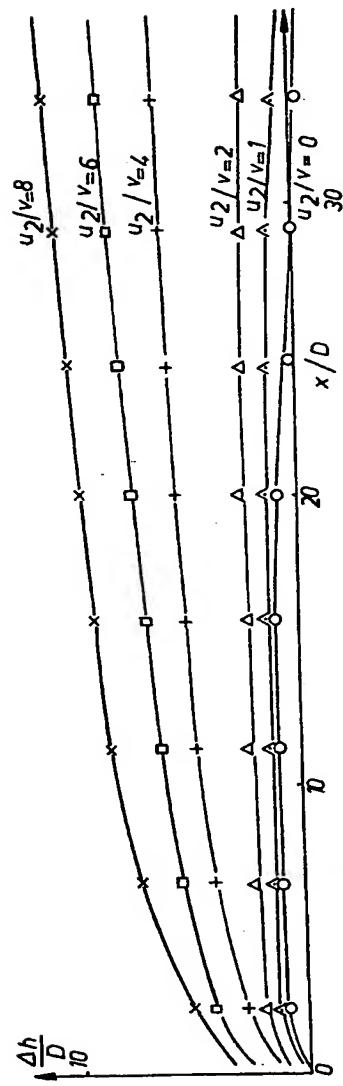


FIG.5

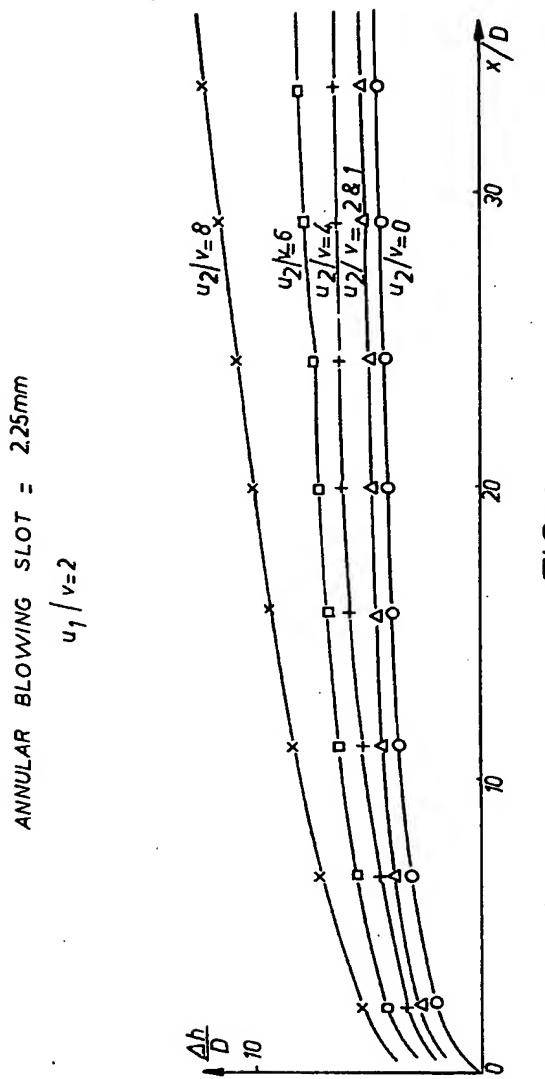
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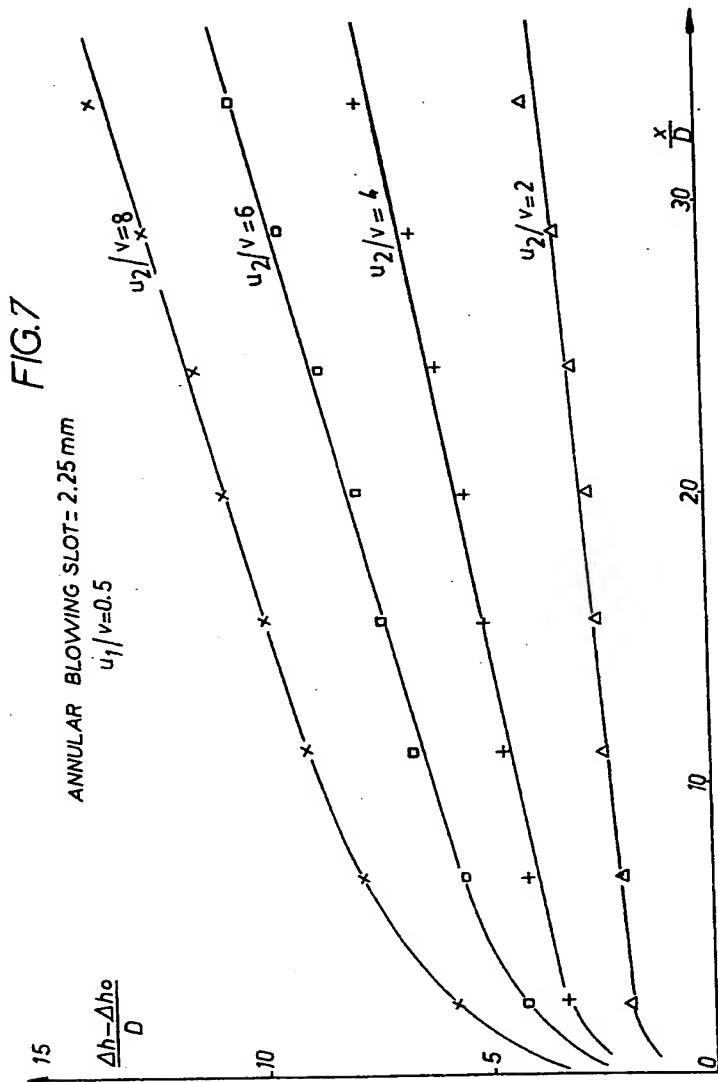
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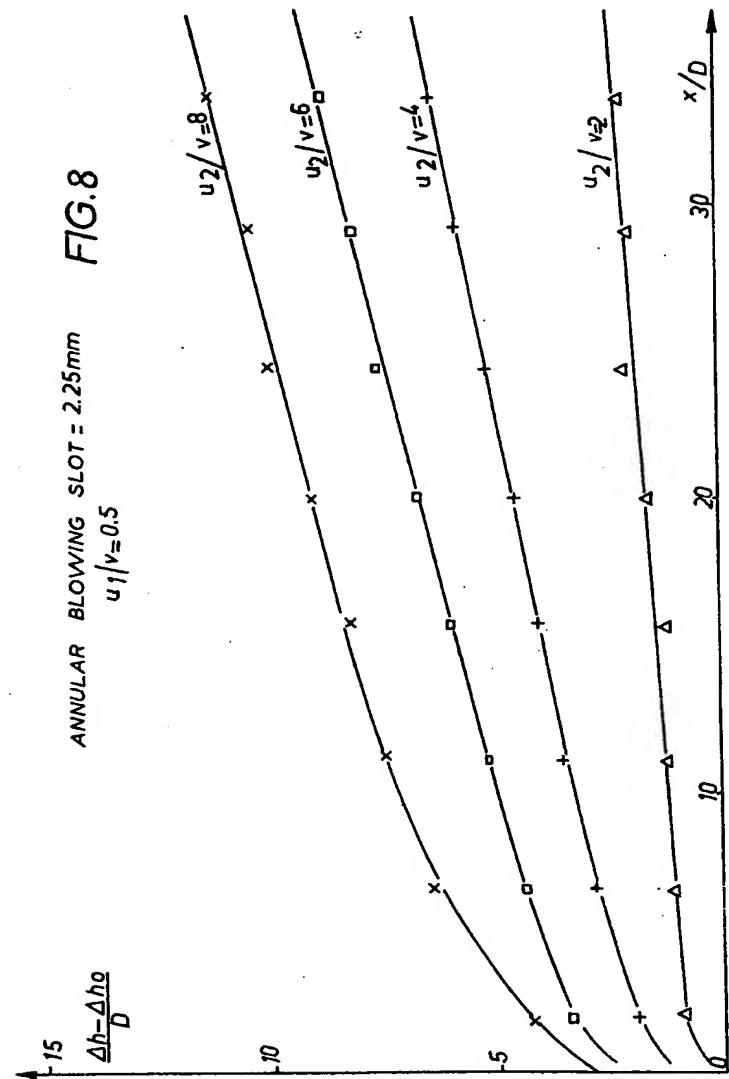
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Sheet 4







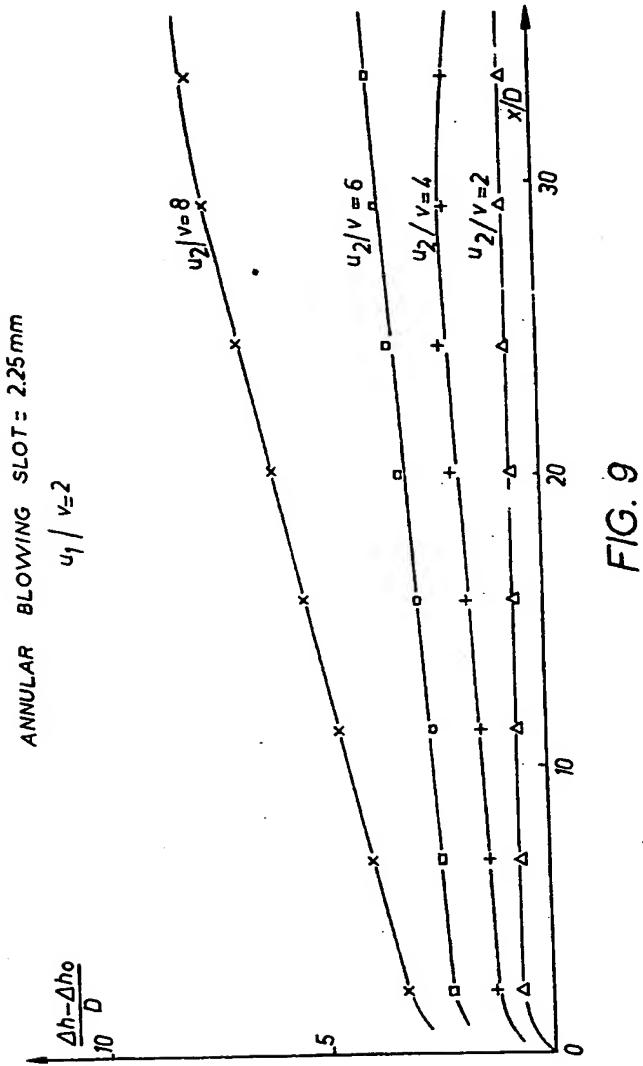


FIG. 9

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Sheet 8

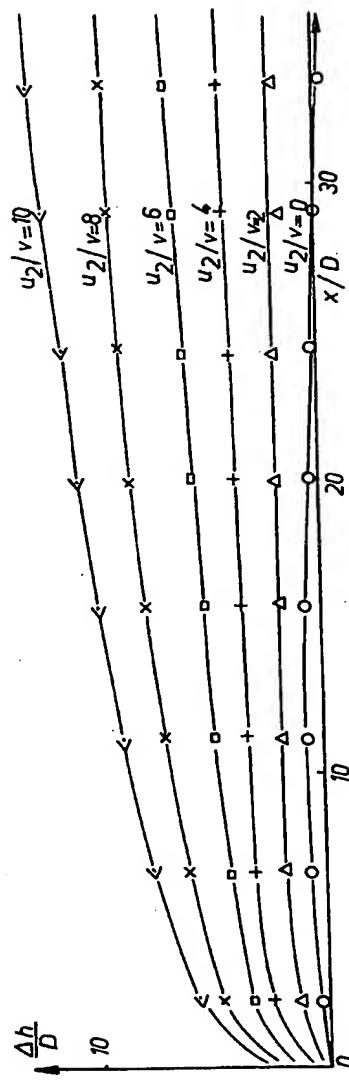
ANNULAR BLOWING SLOT = 5mm  
 $u_1 / v = 1$ 

FIG.10

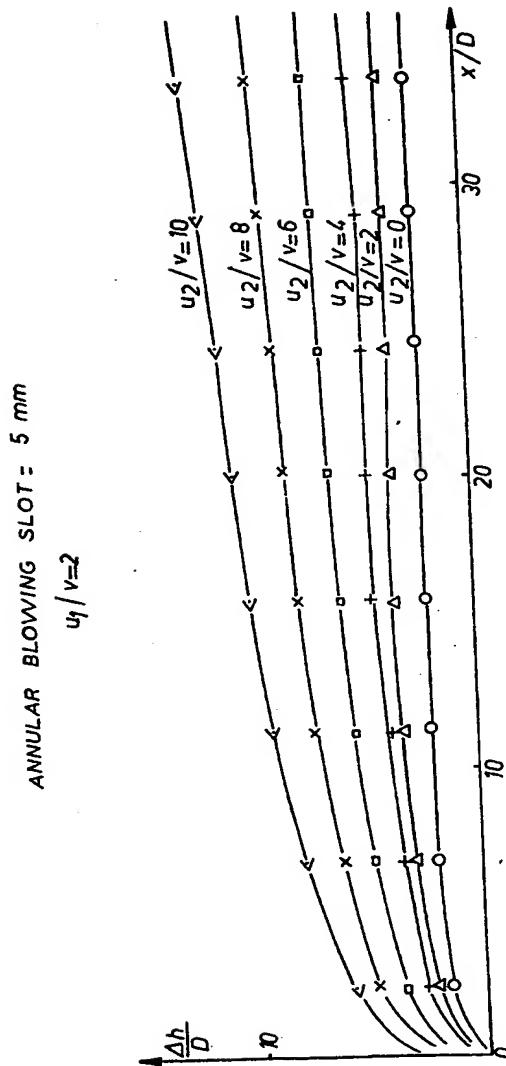


FIG.11

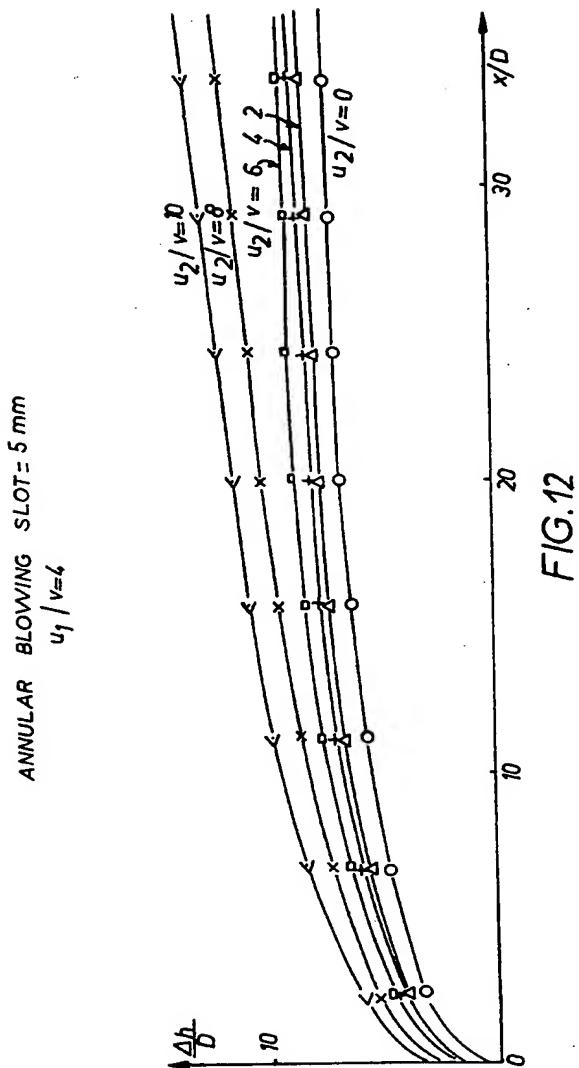
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COMPLETE SPECIFICATION

10 SHEETS

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Sheet 10



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